

REMARKS

Claims 1-3, 5-7, and 9 were rejected for anticipation in view of Marko. Claims 4 and 8 were rejected as unpatentable over Marko in view of Carlson. Applicant requests reconsideration.

New claim 10 was added to recite that the baseband waveform signal as claimed has zero crossings from which pulses are generated. New claim 11 was added to recite the baseband waveform signal is modulated using various modulation methods.

Marko's system does not generate transition pulses, and does not generate transition pulses from zero crossings, does not generate transition pulses from zero crossings of baseband signals, and does not generate transition pulses that are synchronized to the baseband waveform signal.

Claim 1 in part reads: "A timing recovery loop for generating adjusted timing pulses from a baseband signal waveform encoding a self clocking digital bit stream, the timing recovery loop comprising,

a pulse detector for generating data transition pulses from the baseband signal waveform the data transition pulses being synchronized to the baseband waveform,

a timing pulse delay adjustor for delaying the adjusted timing pulses for synchronizing the adjusted timing pulses with the data transition pulses and with the baseband signal

1 Yet the examination states "The applicant also indicates the
2 recovered data signal as disclosed in Marko is not a wideband
3 waveform encoding a digital bit stream. Such a limitation is not
4 recited in the claim, thus, such limitation has not been
5 considered." Apparently, claim 1 has also not been fully considered
6 for what it literally claims and suggests that the examination has
7 failed to understand the significance of the technology disclosed,
8 the claims recited, the cooperative interaction of the claimed
9 elements, or the advancement in the art. The examination appears
10 oriented toward arguing that applicant's transition pulses are the
11 same as Marko's transitions. The examination to date has apparently
12 failed to fully comprehend what is the invention. This is
13 remarkable. In order to focus and assist the examination, applicant
14 added claim 10 which directly claims the zero crossings of the
15 baseband waveform signal. However, the examination did not examine
16 as to new claims 10 and 11, and hence, yet another RCE.

17
18 Perhaps applicant can be of assistance. In the world of
19 communications, transmitted signals are downconverted from the RF
20 regime to baseband waveform signals through carrier demodulation.
21 The baseband waveform signal typically has transitions through the
22 zero ground voltage level referred to as zero crossings. Zero
23 crossings are well known features. A simple comparator to ground
24 will toggle as the baseband waveform signal crosses zero voltage
25 level. The baseband waveform signal is characterized by a signal
26 moving between positive and negative voltages, for example, a
27 sinusoidal signal, having repeating zero crossings. A
28 characteristic of these baseband waveform signals is that they

1 normally do not have abrupt transitions, but rather have smooth
2 signaling when moving between positive and negative voltage levels,
3 and through the zero crossings. As such, baseband waveform signals
4 cross zero voltage in each cycle that may be of a bit duration.

5
6 A data demodulator can further demodulate the baseband
7 waveform signal into a digital signal characterized as having highs
8 and lows, such as Marko's recovered data signal 406. In common TTL
9 logic circuitry, for example, the high state is about 3.5V and the
10 low state is about 0.2V, when operating on conventional +5V power
11 rails of +5.0Vdc and 0.0Vdc. Due to internal transistor voltages
12 necessary for switching, the output does not switch between 0V and
13 5V, but rather switches between 0.2 and about 3.5V. The digital bit
14 stream is thus a digital signal, characterized as having two states
15 and transits between these two states in a digital bit stream. This
16 digital signal does not have any zero crossings, a consequence of
17 the baseband waveform being demodulated into a digital signal. The
18 digital signal is also considered, due to its low frequency, to be
19 a baseband signal.

20
21 Thus, there is an inherent difference between a baseband
22 digital signal and a baseband waveform signal. A baseband digital
23 signal abruptly transits between the two states e.g. 3.5V and 0.2V.
24 A baseband waveform signal smoothly transits through zero voltage
25 level during a zero crossing from a predetermined maximum voltage
26 at a maximal level to minimum voltage at a minimal level. The
27 baseband waveform signals have repeating zero crossing transitions

1 whereas baseband digital signals have repeating transitions
2 completely above zero voltage.

3
4 The background of the current application made reference to the
5 prior art, of which Marko is one of many examples, where digital
6 systems have long used random walk filters. The present invention
7 also uses a random walk filter. A random walk filter counts MINUS
8 early events and PLUS lag events, and accumulates these events over
9 time. Consecutive early events or consecutive late events indicates
10 that timing is off, and an adjustment is needed, to center the
11 timing between early times and late times.

12
13 Marko demodulates the received signal into the recovered data
14 signal 406 using a demodulator. The recovered data has transitions,
15 particularly leading and trailing transitions of a digital bit
16 stream. These transitions are bit boundaries. These transitions can
17 occur at various times, that is, the trailing transition occurs at
18 a multiple of some digital sampling time after the leading
19 transition. Marko teaches that the recovered data boundaries are in
20 1/32 increments. As such, the transitions are not perfectly aligned
21 in time and timed to the baseband waveform signal, but rather, are
22 closely timed within 1/32 of the bit duration. The recovered data
23 signal and a recovered clock signal are phase detected for
24 generating early and late events that are accumulated. In
25 determining the early and late events, transitions of the recovered
26 clock are compared to transitions of recovered data. That is, two
27 digital streams are phase compared using respective transitions.
28 The recovery clock is used to sample the recovered data signal for

1 determining the data bit stream. When the accumulation of early or
2 late events occur, the recovery clock is adjusted by a reference
3 clock, so that, the recovery clock is more centered within a bit
4 duration of the recovered data so as to more precisely sample the
5 recovered data in the bit center for precisely generating the data
6 bit stream. The adjustment to the reference clock however is done
7 by dividing by either 31 or 33. That is, the recovery clock is also
8 adjusted by $1/32$ duty cycle duration. The $1/32$ bit boundaries of
9 the recovered data signal is a major error to precise bit timing.
10 The $1/32$ duty cycle duration of the recovered clock is a minor
11 error to precise bit timing.

12
13 The present invention does not firstly represent the baseband
14 waveform signal by a digital bit stream, as does Marko.
15 Significantly, the present invention generates transition pulses
16 directly from the baseband waveform signal as the baseband waveform
17 signal crosses zero. The transition pulses are directly aligned in
18 time to the zero crossings of the baseband waveform signal, and as
19 such, the transition pulses are in fact synchronized to the
20 baseband waveform signal. Because the transition pulses are
21 precisely aligned in time to the baseband waveform signal and are
22 thus synchronized to the baseband waveform signal, there is no
23 MAJOR error associated with the use of the transition pulses
24 relative to the baseband waveform. There of course can be slight
25 error due to noise, but using a baseband waveform signal with a
26 high signal-to-noise ratio, that error is negligible, with the
27 transition pulses perfectly aligned in time and synchronized to the
28 baseband waveform signal.

1
2 These transition pulses are compared, using a window search, to the
3 adjusted timing pulses for generating early and late events that
4 are accumulated. A reference clock can be used for search in the
5 time window. A reference clock duration or multiple of reference
6 clock durations can be used for the comparison. The use of a
7 conventional reference clock duration for searching the window
8 introduces the MINOR errors associated with using a reference clock
9 for determining early and late events. When the early or late
10 accumulated events exceed a predetermined number, the adjusted
11 timing pulses are adjusted.
12

13 The present invention is characterized as generating
14 transition pulses at the very point in time when the baseband
15 waveform signals crosses zero voltage. As noise can be superimposed
16 upon the baseband waveform signals affecting the zero crossings,
17 noise can cause timing problems. When perfectly timed without noise
18 or with high signal-to-noise signal, the transition pulses line up
19 exactly with the zero crossings of the baseband signal thereby
20 eliminating the MAJOR bit boundary timing errors. These transition
21 pulses are then used to generate early and late events to drive the
22 accumulation of events as part of the random walk filter having a
23 count that appears at times to randomly increase and decrease over
24 time.
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1 In the prior response, applicant asserted that: Marko does not
2 anticipate the present invention, at least, because:

3 1) Marko uses a recovered data signal as the input that is not
4 the baseband waveform signal encoding a data bit stream, (and this
5 gives rise to Marko having the MAJOR error while the present
6 invention does not);

7 2) because Marko's early and late increments are based upon
8 phase detection of transitions of the recovered data signal and the
9 recovered clock and not based on pulses generated from the baseband
10 waveform signal, (as there is a clear difference between the
11 generation of early and late events, where Marko compares
12 transitions of the recovered data and recovered clock signals,
13 whereas, the present invention uses a search window between the
14 transition pulses and the adjusted timing pulses); and

15 3) because the phase error in Marko is determined from
16 transitions of two digital signals, and not from transition pulses
17 (where Marko adjusts the recovery clock having the MINOR errors
18 that is coupled to the MAJOR timing bit boundary errors by phase
19 detection comparison to the recovery data, whereas the present
20 invention adjusts the adjusted timing pulses having the MINOR
21 reference clock errors but without coupling the MINOR errors to any
22 MAJOR errors).

23
24 Marko and the present invention are distinguished in a first
25 significant way. Marko demodulates the received signal into the
26 recovered data signal that introduces the bit boundary MAJOR timing
27 error. The present invention completely avoids this bit boundary
28 MAJOR timing error by generating transition pulses aligned in time

1 to the zero crossings, more generally, as generating synchronized
2 transition pulses that are in fact perfectly aligned in time and
3 hence synchronized to the baseband waveform signal. It is this
4 perfect alignment in time that provides exact synchronization that
5 eliminates the MAJOR bit boundary MAJOR time error.

6
7 Marko and the present invention are distinguished in a second
8 significant way. The actual implementation of the random walk
9 filter is completely different. Marko compares transitions of the
10 recovered data and the recovered clock for adjusting the recovered
11 clock, whereas, the present invention uses time aligned
12 synchronized transition pulses and adjusted timing pulses for
13 adjusting the adjusted timing pulses for data detection. In the
14 preferred form, a window search is used for comparing the
15 transition pulses to the adjusted timing pulses for generating the
16 early and late events.

17
18 Marko and the present invention are distinguished in a third
19 significant way. Marko couples the MAJOR bit boundary timing errors
20 with the recovered clock adjustment MINOR clock timing errors when
21 comparing the transition of the recovered data and recovered clock.
22 The present invention uses the transition pulses and the adjusted
23 timing pulses without coupling to the MAJOR and MINOR errors as
24 there simply are not MAJOR bit boundary timing errors in the
25 present invention. The preferred window search introduces the MINOR
26 reference clock MINOR timing errors. But, there is no coupling
27 between the bit boundary MAJOR timing errors and the reference
28 clock MINOR timing errors in the present invention.

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2 Claim 1 particularly recites that transition pulses are
3 synchronized to the baseband waveform. Marko has no transition
4 pulses, nor one that is synchronized by time alignment to the zero
5 crossings that are aligned in time to the baseband waveform and
6 used to generate the transition pulses. Marko simply does not have
7 such transition pulses, or such synchronism, or such synchronism
8 extending over several bit periods.

9
10 Claim 10 particularly recites the zero crossings, so that
11 there would be no misunderstandings between which type baseband
12 signal is being claimed, that is, a baseband waveform signal
13 specifically characterized by repeating zero crossings, and Marko's
14 recovered data signal having bit boundary MAJOR timing errors.

15
16 The repeating zero crossings of the baseband waveform signals
17 and the repeating digital transitions of the recovered data signal
18 are both used for self-clocking for determining an accurate clock
19 in coherent relation to a local oscillator. The high and low states
20 of the digital bit stream and the baseband waveform signals provide
21 informational content for demodulating the signals into data. Both
22 Marko and the present invention use a random walk filter. However,
23 the present invention departs from Marko by using transition pulses
24 timed aligned to the baseband waveform so as to eliminate the MAJOR
25 bit boundary timing errors.

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1 The present invention is fundamentally different than Marko in
2 the manner that affects performance. The present invention
3 generates transition pulses from zero crossings of a baseband
4 waveform signal. With sufficient signal-to-noise ratio, the pulses
5 are exactly positioned at the zero crossings for precise timed
6 aligned and hence synchronization for improved data detection.
7 Marko first demodulates the received signal into the recovered data
8 signal that is a digital bit signal having bit boundaries position
9 in discrete steps representing an inherent MAJOR bit boundary
10 timing error of $1/32$ bit duration. By using time-aligned
11 synchronized transition pulses, the present invention does not
12 suffer from bit boundary MAJOR timing errors. Both Marko and the
13 present invention suffer from the reference clock MINOR timing
14 errors.

15
16 In summary, the present invention is fundamentally different
17 than Marko in a manner that directly affects performance. There are
18 two major contributions to timing errors. A first and dominant
19 contribution is the creation of transitions relative to the
20 baseband signal by bit boundaries. The second and minor
21 contribution is the increment in the data detection timing where
22 adjustment is made to the recovered clock in Marko or the adjusted
23 timing pulses of the present invention.

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1 The present invention generates transition pulses at zero
2 crossings from a baseband waveform signal. The zero crossing
3 transitions are compared to the adjusted timing pulses to further
4 adjust the adjusted timing pulses. As such, the first and dominant
5 contribution to timing error is effectively zero with high signal-
6 to-noise ratio for accurate zero crossing detection. The timing
7 recovery loop is limited by the accuracy of the position of the
8 adjusted pulses to the actual zero crossings of the signal
9 waveforms. A high speed reference clock is used to adjust the
10 adjusted timing pulses in very small increments as a minor
11 limitation of accuracy. Thus, the present invention has no
12 limitation on the dominant MAJOR bit boundary errors, but retains,
13 like Marko, the MINOR reference clock timing error associated with
14 fine increments of the adjusted pulses from using any high speed
15 reference clock. As such, the present invention eliminates the
16 dominant MAJOR bit boundary timing error by using time-aligned
17 synchronized transition pulses and only retains the minor error
18 associated with increments of adjustment of the adjusted timing
19 pulses from a reference clock.

20
21 Marko first digitizes the baseband waveform into a digital bit
22 stream having the $1/32$ bit boundary MAJOR timing error inherent as
23 the dominant error. Next, Marko uses a high speed reference clock
24 2.304 MHz (32 times 72 kHz) clock that is then divided by 31 or 33
25 so as to introduce a MINOR reference clock timing error, at $1/32$ of
26 the MAJOR timing error, associated with incremental adjustment of
27 the recovery clock. As such, Marko has coupled the major bit
28 boundary timing error and the minor reference clock timing error

1 associated with conventional digital tracking loops using random
2 walk filters. As the signal-to-noise ratio of an incoming signal
3 increases, the present invention transition pulses are exactly time
4 aligned eliminating any offset, but Marko will still retain the
5 MAJOR bit boundary timing error, as a severe limitation.

6
7 Marko does not anticipate the present invention because 1)
8 Marko uses a recovered data signal as the input and not the
9 baseband waveform encoding a data bit stream; 2) because Marko's
10 early and late increments are based upon transitions of the
11 recovered data signal and not based on precise transition pulses
12 generated from the baseband waveform; and 3) because the phase
13 error in Marko is determined from transitions of a digital bit
14 stream, and not from transition pulses of zero crossings from
15 baseband waveform, resulting in phase error that is a coupling of
16 the bit boundary timing errors with reference clock timing errors.

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1 Marko does not suggest the present invention, at least,
2 because: 1) Marko teaches away from the present invention by
3 firstly demodulating the received signals into a recovered data
4 signals in advance of data detection introducing bit boundary
5 timing errors, which is completely contrary to applicant's data
6 detection directly upon zero crossings of the baseband waveform, 2)
7 because Marko's demodulation of the received signals into the
8 recovered data signals injects jitter errors due to discrete 1/32
9 bit boundaries quantization, that is counter-intuitive to the use
10 of zero crossings of baseband waveform signals. Applicant requests
11 allowance of claims.

12
13 Respectfully Submitted

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